



# WorleyParsons

resources & energy

## Genesis Solar Energy Project

### Evaporation Pond Sizing Calculation - Description

By: Janine Forrest

Cked: Jared Foster

Date: 12/7/2009

#### General

- 1) The purpose of this calculation is to estimate the required evaporation pond acreage.
- 2) Site Precipitation data are based on Blythe, CA.
- 3) Dry Bulb Temperature and Wind Speed from Ford Dry Lake Typical Data Year, and
- 4) Relative Humidity from NOAA <http://lwf.ncdc.noaa.gov/oa/climate/online/ccd/avgrh.html>
- 3) Site evaporation data are based on Indio Fire Station, CA (approximately 70 miles west of Site but closest data point) pan evaporation rate data as found at <http://www.wrcc.dri.edu/htmlfiles/westevap.final.html#CALIFORNIA>
- 4) Discharged TDS is based on the site specific mass balance.
- 5) Discharged flow rates are based on the site specific water balance.

#### Instructions

Under the "Inputs" tab:

- 1) Manually enter the "Pond Design" data required. The Pond Depth for Solids, Water and Freeboard, Annual Operation and Total Operation Duration must all be manually entered. Pond Top/Pond Bottom ratio and Ave Pond Bottom Area is based on three ponds, with one side set at 400 feet therefore must be manually changed if different design.
- 2) Manually enter all data for "Makeup/Blowdown Water Parameters". If the cooling tower make-up water TDS and the cycles of concentration are known, they should be entered in items 10 and 11. If the make-up TDS concentration is not known or the blowdown TDS concentration is altered due to other wastewater streams, the estimated blowdown TDS concentration should be manually entered in item 13.
- 3) Manually enter the Max and Min Dry Bulb temperatures, the Morning and Afternoon Relative Humidities and the Wind Speed data under "Site Weather Data".
- 4) Manually enter the Published Evaporation rate (Class "A" pan), the desired Lake Evaporation Factor, the estimated Pond TDS Concentration and the published Monthly Precipitation for the site under "Evaporation Table". Select which months spray nozzle operation is desired.
- 5) Manually enter the 24x12 net electricity generation for the facility. This data will have been generated separately by a solar modeling program.

Under the "Pond YEAR 1" tab:

- 1) Use the "Goalseek" function to set cell C13 to 0 by changing cell C16 on the "Inputs" tab (Inputs!C16).
- 2) The top and bottom of pond areas are now populated on the "Inputs" tab.

#### Calculations

##### Solids

- 1) Solids were calculated by converting the estimated pond inlet TDS from concentration to total solids through the life of the plant. The concentration is provided in ppm, which is the equivalent to mg/L.
- 2) The concentration must first be converted into the units of lb/gal.
- 3) Next the concentration is multiplied by the Spring/Fall Blowdown flow rate thus resulting in the average lb/min entering the ponds.
- 4) This average value is then multiplied by the estimated Annual Operation hours of the plant and then by the Total Operating Duration (design years of plant) giving the total lbs of TDS generated through the life of the plant.
- 5) The total mass of solids is converted to volume by using the assumed Dry TDS Solids Density.
- 6) The depth of dry solids is calculated by dividing the volume of solids produced by the Average Bottom of Pond Area. This results in a conservative depth estimate as it does not account for the slope of the pond sides.
- 7) To determine the depth of solids for a given year the total depth over the life of the pond is scaled per year.
- 8) A factor of 2X is applied to the dry solids depth in the pond sizing calculations to account for the additional space required for storage of wet solids versus dry solids.

##### Monthly Blowdown

- 1) Design blowdown rates are obtained from a water balance for Summer, Spring/Fall and Winter ambient conditions. The flow rate for each season is the equivalent for 100% net electricity production for that given season. The blowdown flow rate will reduce linearly with the electricity production in times when 100% plant capacity is not attainable (i.e. Summer = 215 gpm design for 125 MW, therefore flow rate would be 107 gpm for 63 MW during summer conditions).
- 2) The 24x12 net electricity generation for the facility gives an hourly average for each hour of the year thus

enabling the estimation of the average blowdown flow rate for each hour of the year. May, June, July and August were chosen for the Summer months; September, October, March and April were chosen for the Spring/Fall months; and November, December, January and February were chosen for the Winter months. Net plant power generation data is estimated by use of Solar Advisor Model (SAM) as released by NREL.

- 3) The estimated blowdown rate for each season (in gallons per hour) was multiplied by the total electricity (MWh) produced in each appropriate month and divided by 125 MW thus resulting in the total gallons of blowdown entering the evaporation ponds for each month.

#### Pond Evaporation Rate

- 1) Published Class "A" pan evaporation rates are used but must be converted to pond evaporation rates by the use of the following equations:

$$Evaporation = (PanEvaporationRate - Precipitation) * LakeFactor * SalinityFactor$$

- 2) Published daily average precipitation for each month is used.
- 3) Lake Factor based on information from Membrane Concentrate Disposal: Practices and Regulation, Mikey & Associates 98-FC-81-0054.
- 4) The Salinity Factor is calculated by the following equation:

$$SalinityFactor = 1 - 0.0086 * \%TDS$$

Highly saline waters have a factor of 0.7 (sea water has a 34.5% salinity). Due to the high values of chlorine and sodium in the evaporation pond discharge, the 34.5%TDS shall be adopted for this project.

This is consistent with a evaporation ponds sized for brine concentrator discharge

Reference: Review and Discussion on Evaporation Rate of Brines, December 2000, actis Environmental Services.

- 5) The Pan Evaporation Rate values are given monthly with a units of inches/acre-month. The pond acreage used to calculate the inches/month of evaporation is at the top of the solids storage section of the pond. This level can be easily maintained throughout the life of the pond and provides a conservative approach in that the water level will always be above the solids level and the smallest possible are for evaporation is chosen by using the top of the solids storage area.

#### Spray Nozzle Evaporation

- 1) Evaporation from spray nozzles is based on the following equation as published in the Journal of Applied Sciences 9 (3): 597-600, 2009:

$$E = 4.375 \exp^{0.106u} (e_s - e_o)^{-0.0092} T^{-0.102}$$

where, E = Evaporation Losses (% of nozzle discharge)

u = Wind Speed (mph)

T = Ambient Dry Bulb (°C)

(e<sub>s</sub> - e<sub>o</sub>) = Vapor Pressure Deficit (mbar)

The Vapor Pressure Deficit is calculated by the following equation:

$$(e_s - e_o) = 0.611 \exp \left( \frac{17.27T}{237.3+T} \right) \left( 1 - \frac{RH}{100} \right)$$

where, (e<sub>s</sub> - e<sub>o</sub>) = Vapor Pressure Deficit (mbar)

T = Ambient Dry Bulb (°C)

RH = Relative Humidity

- 2) The above equations do not account for drift losses. However, since the nozzles will be centrally located on the evaporation pond with > 100 ft to the nearest pond edge, drift losses are expected to be minimal.
- 3) Nozzle discharge is the blowdown for each given month.

#### Pond Sizing

- 1) The monthly average blowdown (pond inflow), pond evaporation (pond outflow) and spray nozzle evaporation (when chosen) are calculated and the blowdown is subtracted by the pond and spray nozzle evaporation values. In some months this value will result in a negative value showing that more water evaporated for that month than what has entered the evaporation pond.
- 2) When the value is greater than zero, the remaining water level is carried over the next month. At no time is overall water volume in the pond permitted to go below zero or greater than the maximum capacity of the designated pond depth for water.
- 3) The maximum capacity for water is calculated based solely on the depth permitted for water and does not take into account the area below it for solids. This provides a conservative approach in the early years of operation but becomes more accurate in later years of operation.
- 4) The data is extrapolated over 30 yrs and listed on the Summary Table.



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### Evaporation Pond Sizing Calculation - Inputs

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Date: 12/7/2009

#### Pond Design

1) Top of Pond Area	24 acres	(Rounded up to nearest acre)
2) Pond Top/Bottom Ratio	83%	(Based on rectangle pond design (400ft width) with 3:1 slopes and total pond depth below)
3) Avg Bottom of Pond Area	20.0 acres	
4) Pond Depth for Solids	3 ft	(to account for maximum depth of sludge before clean out is required for safety purposes)
5) Pond Depth for Water	3 ft	
6) Pond Freeboard	2 ft	
7) Total Pond Depth	8 ft	
8) Annual Operation	3,213 hrs/yr	From Solar Advisor Model Hourly Data
9) Total Operating Duration	30 yrs	

#### Make-up/Blowdown Water Parameters

10) Make-up Water TDS Conc.	5000 ppm	(Genesis 5000 TDS Water Balance (2009AUG13) REV B
11) Cycles of Concentration	15	(Genesis 5000 TDS Water Balance (2009AUG13) REV B
12) Blowdown TDS Conc. (calc.)	3152 ppm	(Genesis 5000 TDS Water Balance (2009AUG13) REV B
13) Evaporation Pond Feed TDS Cc	48,584 ppm	(Genesis 5000 TDS Water Balance (2009AUG13) REV B
14) Dry TDS Solids Density	80 lb/ft <sup>3</sup>	(estimate for wet sludge)
15) Summer Blowdown	215 gpm	(Genesis 5000 TDS Water Balance (2009AUG13) REV B
16) Spring/Fall Blowdown	182 gpm	(Genesis 5000 TDS Water Balance (2009AUG13) REV B
17) Winter Blowdown	149 gpm	(calculated from Summer and Spring/Fall flowrates)

#### Site Weather Data

Source Data Location Ford Dry Lake, CA Typical Data Year (Dry Bulb Temperatures and Wind Speed) and Yuma, AZ (Relative Humidity - Data through 2002)

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max Dry Bulb (°F)	68.3	67.6	72.1	81.0	98.8	99.9	104.4	105.4	95.2	85.1	76.8	64.8	84.9
Average Min Dry Bulb (°F)	46.2	49.3	52.9	58.9	72.9	73.2	82.4	84.6	78.1	64.4	56.5	43.9	63.6
Average Dry Bulb (°F)	57.2	58.4	62.5	69.9	85.8	86.5	93.4	95.0	86.6	74.8	66.7	54.3	74.3
Average RH (morning)	57.0	56.0	52.0	47.0	44.0	41.0	49.0	55.0	57.0	54.0	56.0	58.0	52.2
Average RH (afternoon)	28.0	24.0	21.0	17.0	15.0	13.0	22.0	24.0	24.0	23.0	27.0	32.0	22.5
Average RH (total)	42.5	40.0	36.5	32.0	29.5	27.0	35.5	39.5	40.5	38.5	41.5	45.0	37.3
Average Windspeed (mph)	4.3	5.8	6.0	6.7	6.9	7.4	7.8	7.2	6.3	5.1	4.3	4.3	6.0



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### Evaporation Pond Sizing Calculation - Inputs

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#### Evaporation Table

Source Data Location Indio Fire Station, CA (Evaporation - Average 1927 - 2005) and Blythe CAA Airport (Precipitation - Average 1948 to 2008)

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Published Evaporation (in)	2.85	4.38	7.15	9.98	12.73	14.85	14.95	13.59	10.80	7.60	3.98	2.49	105.35
Lake Evaporation Factor	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70
Predicted %TDS in Pond	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5
Salinity Factor	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70
Monthly Precipitation (in)	0.47	0.43	0.36	0.16	0.02	0.02	0.24	0.63	0.36	0.26	0.20	0.40	3.55
Monthly Evaporation (in)	1.17	1.94	3.34	4.83	6.26	7.30	7.24	6.38	5.14	3.61	1.86	1.03	50.12
Operate Spray Nozzles (Y/N)	No	No	No	No	No	No	No	No	No	No	No	No	No

#### Net Plant Generation (On-line hours only)

NET OUTPUT TABLE FOR		125	MW SOLAR PROJECT										
Hour Starting	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
0	0	0	0	0	0	0	0	0	0	0	0	0	-
1	0	0	0	0	0	0	0	0	0	0	0	0	-
2	0	0	0	0	0	0	0	0	0	0	0	0	-
3	0	0	0	0	0	0	0	0	0	0	0	0	-
4	0	0	0	0	0	0	0	0	0	0	0	0	-
5	0	0	0	0	0	0	0	0	0	0	0	0	-
6	0	0	0	12	51	66	32	11	0	0	0	0	14
7	19	34	44	79	110	123	96	81	75	42	8	0	59
8	47	56	96	109	114	123	106	98	105	84	52	16	84
9	46	50	96	111	118	122	104	106	109	86	57	42	87
10	48	45	97	110	114	122	116	103	107	82	55	43	87
11	49	39	92	111	114	120	114	101	105	80	52	38	85
12	55	47	92	117	115	122	107	107	101	87	57	44	87
13	65	60	98	117	113	122	111	108	101	95	62	52	92
14	60	77	92	99	112	121	108	108	97	96	68	61	92
15	0	22	89	95	110	117	112	106	100	84	39	46	77
16	0	0	67	77	94	104	98	87	67	5	0	0	50
17	0	0	0	0	27	56	49	21	1	0	0	0	13
18	0	0	0	0	0	0	0	0	0	0	0	0	-
19	0	0	0	0	0	0	0	0	0	0	0	0	-
20	0	0	0	0	0	0	0	0	0	0	0	0	-
21	0	0	0	0	0	0	0	0	0	0	0	0	-
22	0	0	0	0	0	0	0	0	0	0	0	0	-
23	0	0	0	0	0	0	0	0	0	0	0	0	-
Total (MWhr)	390	431	863	1,037	1,191	1,317	1,153	1,036	969	742	449	343	
Days/month	31	28	31	30	31	30	31	31	30	31	30	31	
Monthly Totals (MWhr)	12,100	12,072	26,747	31,116	36,922	39,497	35,752	32,119	29,055	22,990	13,484	10,635	

Genesis Solar Energy Project														
Evaporation Pond Sizing Calculation														
By: Janine Forrest														
Checked: Jared Foster														
Date: 12/7/2009														
THREE PONDS OPERATING IN YEAR 1														
Year	1													
Top of Pond Area, ac	24													
Solids Depth, ft	0.41													
Pond Depth for Water, ft	3													
Starting Pond Depth for Solids, ft	3													
Available Pond Depth for Solids, ft	2.59													
Year 10 Minus Year 1 Carry Over Volume	0	(Make 0 by changing "Avg Bottom of Pond Area" on "Inputs" page)												
Evaporation (inches/month)	7.2	6.4	5.1	3.6	1.9	1.0	1.2	1.9	3.3	4.8	6.3	7.3	50	Estimated Annual Average Evaporate
Average Dry Bulb (°F)	93.4	95.0	86.6	74.8	66.7	54.3	57.2	58.4	62.5	69.9	85.8	86.5	74.3	
Average Dry Bulb (°C)	34.1	35.0	30.4	23.8	19.3	12.4	14.0	14.7	17.0	21.1	29.9	30.3	23.5	
Average Relative Humidity	35.5	39.5	40.5	38.5	41.5	45.0	42.5	40.0	36.5	32.0	29.5	27.0	37.3	
Windspeed (mph)	7.8	7.2	6.3	5.1	4.3	4.3	4.3	5.8	6.0	6.7	6.9	7.4	6.0	
Hour starting	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total	July to June
Days/month	31	31	30	31	30	31	31	28	31	30	31	30	365	Days per year
gal/month Inflow from Plant	3,689,604	3,314,705	2,538,260	2,008,440	964,369	760,614	865,397	863,390	2,336,645	2,718,336	3,810,320	4,076,105	27,946,185	Inflow from Plant (gal)
Spray Evaporation (% of Inflow)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
gal/month Outflow (spray evap)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	Outflow - Spray Evap (gal)
gal/month Outflow (pond evap)	4,172,040	3,675,707	2,960,986	2,081,766	1,072,081	592,764	675,014	1,120,296	1,925,775	2,785,142	3,604,802	4,206,075	28,872,448	Outflow - Pond Evap (gal)
Net gal/month total	-482,437	-361,002	-422,725	-73,326	-107,712	167,849	190,383	-256,907	410,870	-66,806	205,519	-129,970	-926,263	Net (Inflow - Outflow)
Carry over Volume to next month gal	0	0	0	0	0	167,849	358,232	101,326	512,196	445,390	650,909	520,939		
Available Volume gal/month	21,483,374	21,483,374	21,483,374	21,483,374	21,483,374	21,315,525	21,125,142	21,382,048	20,971,178	21,037,984	20,832,465	20,962,435	20,962,435	Available Volume at end of calendar year
Maximum Capacity without freeboard	21,483,374	21,483,374	21,483,374	21,483,374	21,483,374	21,483,374	21,483,374	21,483,374	21,483,374	21,483,374	21,483,374	21,483,374	21,483,374	Maximum Capacity without freeboard
reference files:														

Genesis Solar Energy Project														
Evaporation Pond Sizing Calculation														
By:	Janine Forrest													
Checked:	Jared Foster													
Date:	12/7/2009													
THREE PONDS OPERATING IN YEAR 2														
Year	2													
Top of Pond Area, ac	24													
Solids Depth, ft	0.82													
Pond Depth, ft	3													
Pond Depth for Solids, ft	2.18													
outflow (in/month)	7.2	6.4	5.1	3.6	1.9	1.0	1.2	1.9	3.3	4.8	6.3	7.3	50.1	Estimated Annual Average Evaporate
Average Dry Bulb (°F)	93.4	95.0	86.6	74.8	66.7	54.3	57.2	58.4	62.5	69.9	85.8	86.5	74.3	
Average Dry Bulb (°C)	34.1	35.0	30.4	23.8	19.3	12.4	14.0	14.7	17.0	21.1	29.9	30.3	23.5	
Average Relative Humidity	35.5	39.5	40.5	38.5	41.5	45.0	42.5	40.0	36.5	32.0	29.5	27.0	37.3	
Windspeed (mph)	7.8	7.2	6.3	5.1	4.3	4.3	4.3	5.8	6.0	6.7	6.9	7.4	6.0	
Hour starting	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total	July to June
Days/month	31	31	30	31	30	31	31	28	31	30	31	30	365	Days per year
gal/month Inflow from Plant	3,689,604	3,314,705	2,538,260	2,008,440	964,369	760,614	865,397	863,390	2,336,645	2,718,336	3,810,320	4,076,105	27,946,185	Inflow from Plant (gal)
Spray Evaporation (% of Inflow)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	Outflow - Spray Evap (gal)
gal/month Outflow (spray evap)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	Outflow - Pond Evap (gal)
gal/month Outflow (evap)	4,172,040	3,675,707	2,960,986	2,081,766	1,072,081	592,764	675,014	1,120,296	1,925,775	2,785,142	3,604,802	4,206,075	28,872,448	Net (Inflow - Outflow)
Net gal/month total	-482,437	-361,002	-422,725	-73,326	-107,712	167,849	190,383	-256,907	410,870	-66,806	205,519	-129,970	-926,263	
Carry over Volume to next month gal	38,502	0	0	0	0	167,849	358,232	101,326	512,196	445,390	650,909	520,939		
Available Volume gal/month	21,444,872	21,483,374	21,483,374	21,483,374	21,483,374	21,315,525	21,125,142	21,382,048	20,971,178	21,037,984	20,832,465	20,962,435	20,962,435	Available Volume at end of calendar year
Maximum Capacity without freeboard	21,483,374	21,483,374	21,483,374	21,483,374	21,483,374	21,483,374	21,483,374	21,483,374	21,483,374	21,483,374	21,483,374	21,483,374	21,483,374	Maximum Capacity without freeboard
Carryover from previous year	20,962,435													
reference files:														

Genesis Solar Energy Project														
Evaporation Pond Sizing Calculation														
By: Janine Forrest														
Checked: Jared Foster														
Date: 12/7/2009														
TWO PONDS OPERATING IN YEAR 1														
Year	1													
Top of Pond Area, ac	16	2 PONDS OPERATING ONE, OUT OF SERVICE												
Solids Depth, ft	0.63													
Pond Depth for Water, ft	3													
Starting Pond Depth for Solids, ft	3													
Available Pond Depth for Solids, ft	2.37													
Year 10 Minus Year 1 Carry Over Volume	81,893,464	(Make 0 by changing "Avg Bottom of Pond Area" on "Inputs" page)												
Evaporation (inches/month)	7.2	6.4	5.1	3.6	1.9	1.0	1.2	1.9	3.3	4.8	6.3	7.3	50	Estimated Annual Average Evaporate
Average Dry Bulb (°F)	93.4	95.0	86.6	74.8	66.7	54.3	57.2	58.4	62.5	69.9	85.8	86.5	74.3	
Average Dry Bulb (°C)	34.1	35.0	30.4	23.8	19.3	12.4	14.0	14.7	17.0	21.1	29.9	30.3	23.5	
Average Relative Humidity	35.5	39.5	40.5	38.5	41.5	45.0	42.5	40.0	36.5	32.0	29.5	27.0	37.3	
Windspeed (mph)	7.8	7.2	6.3	5.1	4.3	4.3	4.3	5.8	6.0	6.7	6.9	7.4	6.0	
Hour starting	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total	July to June
Days/month	31	31	30	31	30	31	31	28	31	30	31	30	365	Days per year
gal/month Inflow from Plant	3,689,604	3,314,705	2,538,260	2,008,440	964,369	760,614	865,397	863,390	2,336,645	2,718,336	3,810,320	4,076,105	27,946,185	Inflow from Plant (gal)
Spray Evaporation (% of Inflow)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	Outflow - Spray Evap (gal)
gal/month Outflow (spray evap)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	Outflow - Pond Evap (gal)
gal/month Outflow (pond evap)	2,723,360	2,399,371	1,932,827	1,358,903	699,817	386,936	440,625	731,290	1,257,078	1,818,042	2,353,087	2,745,577	18,846,911	Net (Inflow - Outflow)
Net gal/month total	966,243	915,334	605,434	649,537	264,552	373,678	424,772	132,100	1,079,567	900,294	1,457,234	1,330,528	9,099,274	
Carry over Volume to next month gal	966,243	1,881,577	2,487,011	3,136,548	3,401,100	3,774,778	4,199,550	4,331,650	5,411,217	6,311,512	7,768,745	9,099,274		
Available Volume gal/month	13,166,433	12,251,099	11,645,665	10,996,128	10,731,576	10,357,898	9,933,126	9,801,026	8,721,459	7,821,164	6,363,931	5,033,402	5,033,402	Available Volume at end of calendar year
Maximum Capacity without freeboard	14,132,676	14,132,676	14,132,676	14,132,676	14,132,676	14,132,676	14,132,676	14,132,676	14,132,676	14,132,676	14,132,676	14,132,676	14,132,676	Maximum Capacity without freeboard
PONDS HAVE AVAILABLE CAPACITY AT THE END OF THE YEAR														
reference files:														
					Checked By:					<div><div></div><div>WorleyParsons</div><div>resources &amp; energy</div><div>Evaporation Pond 5000 TDS Raw Water</div></div>				
A	Initial Issue		J.Forrest	12/07/09						GENESIS SOLAR ENERGY PROJECT				
Rev.	Description		By	Date						Rev. A				

By: Janine Forrest  
Checked: Jared Foster  
Date: 12/7/2009

2 PONDS OPERATING  
ONE, OUT OF SERVICE

100 YEAR STORM EVENT  
IN JANUARY

Year	1											100 YEAR STORM EVENT IN JANUARY			
Top of Pond Area, ac	16	2 PONDS OPERATING ONE, OUT OF SERVICE													
Solids Depth, ft	0.63														
Pond Depth for Water, ft	3														
Starting Pond Depth for Solids, ft	3														
Available Pond Depth for Solids, ft	2.37														
Year 10 Minus Year 1 Carry Over Volume	87,741,931	(Make 0 by changing "Avg Bottom of Pond Area" on "Inputs" page)													
Evaporation (inches/month)	7.2	6.4	5.1	3.6	1.9	-0.6	1.9	3.3	4.8	6.3	7.3	48	Estimated Annual Average Evaporate		
Average Dry Bulb (°F)	93.4	95.0	86.6	74.8	66.7	54.3	57.2	58.4	62.5	69.9	85.8	86.5	74.3		
Average Dry Bulb (°C)	34.1	35.0	30.4	23.8	19.3	12.4	14.0	14.7	17.0	21.1	29.9	30.3	23.5		
Average Relative Humidity	35.5	39.5	40.5	38.5	41.5	45.0	42.5	40.0	36.5	32.0	29.5	27.0	37.3		
Windspeed (mph)	7.8	7.2	6.3	5.1	4.3	4.3	4.3	5.8	6.0	6.7	6.9	7.4	6.0		
Hour starting	Jul 31	Aug 31	Sep 30	Oct 31	Nov 30	Dec 31	Jan 31	Feb 28	Mar 31	Apr 30	May 31	Jun 30	Total 365	July to June	
Days/month	31	31	30	31	30	31	31	28	31	30	31	30	365	Days per year	
gal/month Inflow from Plant	3,689,604	3,314,705	2,538,260	2,008,440	964,369	760,614	865,397	863,390	2,336,645	2,718,336	3,810,320	4,076,105	27,946,185	Inflow from Plant (gal)	
Spray Evaporation (% of Inflow)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	Outflow - Spray Evap (gal)	
gal/month Outflow (spray evap)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	Outflow - Pond Evap (gal)	
gal/month Outflow (pond evap)	2,723,360	2,399,371	1,932,827	1,358,903	699,817	386,936	-209,204	731,290	1,257,078	1,818,042	2,353,087	2,745,577	18,197,081	Net (Inflow - Outflow)	
Net gal/month total	966,243	915,334	605,434	649,537	264,552	373,678	1,074,601	132,100	1,079,567	900,294	1,457,234	1,330,528	9,749,103		
Carry over Volume to next month gal	966,243	1,881,577	2,487,011	3,136,548	3,401,100	3,774,778	4,849,380	4,981,480	6,061,047	6,961,341	8,418,575	9,749,103			
Available Volume gal/month	13,166,433	12,251,099	11,645,665	10,996,128	10,731,576	10,357,898	9,283,296	9,151,196	8,071,629	7,171,335	5,714,101	4,383,573	4,383,573	Available Volume at end of calendar year	
Maximum Capacity without freeboard	14,132,676	14,132,676	14,132,676	14,132,676	14,132,676	14,132,676	14,132,676	14,132,676	14,132,676	14,132,676	14,132,676	14,132,676	14,132,676	Maximum Capacity without freeboard	

PONDS HAVE AVAILABLE CAPACITY AT THE END OF THE YEAR

Checked By:



resources &amp; energy

Evaporation Pond 5000 TDS Raw Water

## GENESIS SOLAR ENERGY PROJECT

Rev. A

Genesis Solar Energy Project  
Evaporation Pond Sizing Calculation  
By: Janine Forrest  
Checked: Jared Foster  
Date: 12/7/2009

RAINFALL EVENT IN JANUARY YEAR 1, THREE  
PONDS OPERATING IN YEAR 2

Year	2													
Top of Pond Area, ac	24													
Solids Depth, ft	0.82													
Pond Depth, ft	3													
Pond Depth for Solids, ft	2.18													
outflow (in/month)	7.2	6.4	5.1	3.6	1.9	1.0	1.2	1.9	3.3	4.8	6.3	7.3	50.1	Estimated Annual Average Evaporate
Average Dry Bulb (°F)	93.4	95.0	86.6	74.8	66.7	54.3	57.2	58.4	62.5	69.9	85.8	86.5	74.3	
Average Dry Bulb (°C)	34.1	35.0	30.4	23.8	19.3	12.4	14.0	14.7	17.0	21.1	29.9	30.3	23.5	
Average Relative Humidity	35.5	39.5	40.5	38.5	41.5	45.0	42.5	40.0	36.5	32.0	29.5	27.0	37.3	
Windspeed (mph)	7.8	7.2	6.3	5.1	4.3	4.3	4.3	5.8	6.0	6.7	6.9	7.4	6.0	
Hour starting	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total	July to June
Days/month	31	31	30	31	30	31	31	28	31	30	31	30	365	Days per year
gal/month Inflow from Plant	3,689,604	3,314,705	2,538,260	2,008,440	964,369	760,614	865,397	863,390	2,336,645	2,718,336	3,810,320	4,076,105	27,946,185	Inflow from Plant (gal)
Spray Evaporation (% of Inflow)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	Outflow - Spray Evap (gal)
gal/month Outflow (spray evap)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	Outflow - Pond Evap (gal)
gal/month Outflow (evap)	4,172,040	3,675,707	2,960,986	2,081,766	1,072,081	592,764	675,014	1,120,296	1,925,775	2,785,142	3,604,802	4,206,075	28,872,448	Net (Inflow - Outflow)
Net gal/month total	-482,437	-361,002	-422,725	-73,326	-107,712	167,849	190,383	-256,907	410,870	-66,806	205,519	-129,970	-926,263	
Carry over Volume to next month gal	38,502	0	0	0	0	167,849	358,232	101,326	512,196	445,390	650,909	520,939		
Available Volume gal/month	21,444,872	21,483,374	21,483,374	21,483,374	21,483,374	21,315,525	21,125,142	21,382,048	20,971,178	21,037,984	20,832,465	20,962,435	20,962,435	Available Volume at end of calendar year
Maximum Capacity without freeboard	21,483,374	21,483,374	21,483,374	21,483,374	21,483,374	21,483,374	21,483,374	21,483,374	21,483,374	21,483,374	21,483,374	21,483,374	21,483,374	Maximum Capacity without freeboard
Carryover from previous year	17,052,489													

PONDS HAVE AVAILABLE CAPACITY AT THE END OF THE YEAR

reference files:

				Checked By:	<div><b>WorleyParsons</b> resources &amp; energy Evaporation Pond 5000 TDS Raw Water</div>	
A	Initial Issue	J.Forrest	12/07/09			
Rev.	Description	By	Date		GENESIS SOLAR ENERGY PROJECT	Rev. A

### RAINFALL EVENT IN JUNE, TWO PONDS OPERATING IN YEAR 1

100 YEAR STORM EVENT  
IN JUNE

PONDS HAVE AVAILABLE CAPACITY AT THE END OF THE YEAR

Checked By:



resources &amp; energy

## GENESIS SOLAR ENERGY PROJECT

Rev. A

Genesis Solar Energy Project  
Evaporation Pond Sizing Calculation  
By: Janine Forrest  
Checked: Jared Foster  
Date: 12/7/2009

RAINFALL EVENT IN JUNE YEAR 1, THREE PONDS  
OPERATING IN YEAR 2

Year	2														7.3009573	
Top of Pond Area, ac	24															
Solids Depth, ft	0.82															
Pond Depth, ft	3															
Pond Depth for Solids, ft	2.18															
outflow (in/month)	7.2	6.4	5.1	3.6	1.9	1.0	1.2	1.9	3.3	4.8	6.3	7.30	50.1	Estimated Annual Average Evaporate		
Average Dry Bulb (°F)	93.4	95.0	86.6	74.8	66.7	54.3	57.2	58.4	62.5	69.9	85.8	86.5	74.3			
Average Dry Bulb (°C)	34.1	35.0	30.4	23.8	19.3	12.4	14.0	14.7	17.0	21.1	29.9	30.3	23.5			
Average Relative Humidity	35.5	39.5	40.5	38.5	41.5	45.0	42.5	40.0	36.5	32.0	29.5	27.0	37.3			
Windspeed (mph)	7.8	7.2	6.3	5.1	4.3	4.3	4.3	5.8	6.0	6.7	6.9	7.4	6.0			
Hour starting	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total	July to June		
Days/month	31	31	30	31	30	31	31	28	31	30	31	30	365	Days per year		
gal/month Inflow from Plant	3,689,604	3,314,705	2,538,260	2,008,440	964,369	760,614	865,397	863,390	2,336,645	2,718,336	3,810,320	4,076,105	27,946,185	Inflow from Plant (gal)		
Spray Evaporation (% of Inflow)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	Outflow - Spray Evap (gal)		
gal/month Outflow (spray evap)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	Outflow - Pond Evap (gal)		
gal/month Outflow (evap)	4,172,040	3,675,707	2,960,986	2,081,766	1,072,081	592,764	675,014	1,120,296	1,925,775	2,785,142	3,604,802	4,205,523	28,871,897	Net (Inflow - Outflow)		
Net gal/month total	-482,437	-361,002	-422,725	-73,326	-107,712	167,849	190,383	-256,907	410,870	-66,806	205,519	-129,418	-925,712			
Carry over Volume to next month gal	1,035,705	674,703	251,978	178,652	70,940	238,789	429,172	172,265	583,135	516,330	721,848	592,430				
Available Volume gal/month	20,447,669	20,808,671	21,231,396	21,304,722	21,412,434	21,244,585	21,054,202	21,311,108	20,900,238	20,967,044	20,761,525	20,890,944	20,890,944	Available Volume at end of calendar year		
Maximum Capacity without freeboard	21,483,374	21,483,374	21,483,374	21,483,374	21,483,374	21,483,374	21,483,374	21,483,374	21,483,374	21,483,374	21,483,374	21,483,374	21,483,374	Maximum Capacity without freeboard		
Carryover from previous year	16,055,286															

PONDS HAVE AVAILABLE CAPACITY AT THE END OF THE YEAR

reference files:

				Checked By:	 <b>WorleyParsons</b> resources & energy	
					Evaporation Pond 5000 TDS Raw Water	
A	Initial Issue	J.Forrest	12/07/09		GENESIS SOLAR ENERGY PROJECT	
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